

TPM Volume-11

Total Preventive Maintenance

Oil Control II

2020a Edition

Koichi Kimura



Factory Management Institute

COOPERATING TO REACH EXCELLENCE



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Icons:



Notes: Going and Comeback to the main theme.



Third level of the Issue, in order to provide more clearness to the structure of the text.



Lower levels of the Issue, commonly 6th or 7th And, pointing out necessary explanations about pictures or graphs.

UPDATING TABLE:

Date, Version-Previous & V-Next	Chapter (I..XX...)	Chapter Point.- sub-point : (Updating)

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I. Introduction

In this description, I explained the bus tub curve.

And, before this period which is "Wear Failure Period" comes, we must make efforts to extend the "Accidental Failure Period" in which operation is stable by exchanging the expendable parts and maintenance.

In somewhere I have written that a machine doesn't take age even though to be used very long years. This is one part of dialogue with my old Toyota friend. Why a machine doesn't take age? Because it is possible to exchange the part where to be damaged or worn. And in the combination of maintenance and Kaizen, it is possible to use the machine in very long "Accidental Failure Period".

I also explained the concept of tribology.

I wrote before that it is said that 60% occurrence of failures in moving parts of machine are caused of the problems of lubricants, including lubricant supply.

And when looking the machine failure in overall machine, more than 25% number occurred, more than 27% of machine stop and more than 30% of loss amount are caused of lubricant troubles.

Yes, lubricant control is very important and essential factor for TPM. However, it is true that the systematic oiling is disregarded.

When visiting and looking at the maintenance of machines, I always can find the lack of lubricant control condition which are 5Ss of Oil storage, lack of oiling standard (not correct and/or hackneyed), no keeping the standard (even though the standard is made).

5Ss and maintenance room.

In this description, I didn't write about this theme. Because in somewhere I might have written it.

But once again I ask you to implement 5Ss in a maintenance room which is the stronghold of maintenance activity.

I introduce one episode.

When I made a conference in a company, I was required to make a suggestion about Kaizen. Their problem is to promote Kaizen in Gemba. And one of question was how to systemize Kaizen activity. Then I taught 2 things and one is data gathering system and another one is suggestion scheme.

One year later once again I had an opportunity to visit this company. And I could look at the situation of Kaizen implementation. However, it was a miserable state. I found that a suggestion box became the nest of cockroach and there were the discoloured papers in it.

According to the managers, Kaizen suggestions don't come out as expected and the voice of Gemba was that they cannot come up with Kaizen idea. By the way this company was in the middle of TPM campaign. (I therefore was invited by this company.) Then when making factory tour, we stopped at the maintenance room. It was a chaotic area. It was anyway chaotic. Nude posters, tools scattered, unreadable oil cans and oil servers, a bottle of Coca-Cola... And particularly it was dirty. Is maintenance room a dirty place in the first place? Their excuse was the use of oil and scattering chips

and I lost word. Of course, I denied their excuse. Dirty maintenance room cannot make reasonable maintenance in production Gemba and also very unreliable.

Unreadable oil cans and oil servers, how can they supply correct oil in correct position? And, then I suggested the managers to create 10 thousand Kaizen suggestions in this maintenance room in to implement 5Ss.

10 thousand Kaizen ideas!? ...The managers were surprised. And they said that it is impossible in unison. But I told them as next:

— In Kaizen (Kaizen ideas) there are 3 ranks.

- Excellent (effect to the Gemba); Better effect to be expected;
- Good (effect to Gemba); Also, better effect to be expected;
- And,
- The effect to be better than nothing.

— When you imagine Kaizen, you always expect or imagine "Excellent or Good". But it is wrong. Rather than the expectation of these, you should encourage the ideas of "Better than nothing".

— 10 thousand ideas in maintenance room, it is easy.

— Remove "Nude poster" with the title of "Better working environment". Then, it is one Kaizen suggestion.

— Deciding the location and correct putting method for one tool. This is one Kaizen suggestion. Deciding the location of ash tray and regulation of ash Katazuke. This is one of Kaizen idea. Putting Kanban board of ash tray regulation also additional Kaizen idea.

— In this maintenance room, there are many tools, oils, lubricants, machines, ... And if you suggest ideas for one by one, it is easy to create 10thousands ideas.

Anyway, it is good chance to implement 5Ss and Kaizen suggestions as a maintenance team in TPM Campaign.

Koichi Kimura
International Consultant
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II. COVID-19

Before going to the theme, I would write about some miscellaneous thoughts. But dropping in the way. Therefore, no necessary to read, if you don't want.

In previous description, I have written the Japanese Era Name. Thus, now the era name is "REWA".

As I wrote before, since the Meiji era, the system was changed to one region of Emperor and one era name. But before Meiji, era name was changed more than once in same Emperor when occurring disasters and epidemics for playing people's well-being and peace.

Unfortunately, from the beginning of this new era name, Japan was attacked and damaged by big disasters and currently is been attacking the epidemic of COVID.

This epidemic is very serious and more serious than recent others include the economical epidemic of Financial Crisis of Lehman.

At the Lehman's, the world financial system was damaged and expanded the influence to Gemba. But this COVID directly attacked **Gemba**. And all of **Gembas**, manufacturing sector, service sector, tourism sector, and all of office **Gembas** were attacked. And this disaster influence would be continuing long term (more than 3 years in a passage).

After this disaster (no, during this disaster), something of social system would be changed in the world dramatically. When looking at the world history, such disaster became the trigger of social change.

For instance, and according to a history book, there was a miserable disaster at 14th century, in Europa. Yes, it is plague (Black Death). And this epidemic of plague killed more than 25million people in Europa. And, after this disaster, the Reformation was happened. Also, The Renaissance which ignited people's "inner consciousness" with culture and art raised.

This is related to the fact that the nation, religion, and culture at the time could not cope with mass deaths, and proves that the unprecedented disaster caused social change. In this book there was a word which is "memento mori"¹.

At that time (14th century in Europa), people felt a death closely, because cities overflowed with corpses. And, this "memento mori" became a trigger of social change.

Now again this word was close by the persons who are old persons and/or the persons who have underlying medical problems even though people don't know this word.

It might never reach the death toll to be same level as the plague of 14 century in Europa. But we feel death closely because of daily news with internet.

We saw the scenes of Wuhan hospital, Italy, UK. Also, we saw the scene of refrigerator trucks of corpses in New York, vast burial ground in Brazil. And because of the improvement of Internet, we are in circumstances of looking and feeling death inevitably. This impact might be same to the epidemic of Black Death.

¹ **Memento mori.** Memento Mori is a Latin phrase that means "don't forget to die (someday)" or "don't forget death". Widely used as a motif in art works. Wikipedia: https://en.wikipedia.org/wiki/Memento_mori
https://es.wikipedia.org/wiki/Memento_mori

Many times, I wrote that in a decade working circumstances would change dramatically. However, it might be true that this COVID has the power of accelerating the changing society.

A. Acceleration of Telework

Unfortunately, the trend of telework or remote work of *Office-Gemba* might accelerate.

There are good points and bad points.

For instance, how about Online learning? ...Online learning also will have the citizenship in the world. However, this method also has both sides.

I think Online learning is not a suitable education for children, even though it is necessary as an emergency countermeasure. Because the teaching with through internet is biased to teach just knowledge (*Leftware*² in brain). But this is because the awareness and learning that arises from the existence of a place called school should also be important. Learning about plants and insects on the screen of a computer does not give children an idea of nature. Just as it is necessary to put children in a natural place to know nature, the place of school cannot be replaced online. And it is not possible to bring up the rich sensitivity and emotion (*Rightware*).



Production-Gemba and Office-Gemba.

We notice that some jobs are suitable for telework and some are not. Of course, teleworking cannot be applied to manufacturing sites, face-to-face service industries, and transportation-related work. The same goes for public services such as police office, fire departments and essential working *Gemba* such hospitals, nursing, childcare etc.

On the other hand, even within the company, telework is likely to be established in a job system which employees can take on the task as a contract business. From now on, the style of work that should be called a “craftsman” that surely realizes his/her contracted work may be increase rapidly.

Again, business form & type will change very rapidly, because of the improvement of ICT and the accelerated with such pandemic.

Telework may be a good trend. But I like the form of small group telework (satellite office work) rather than single home telework.

² *Leftware & Rightware*: Concepts associated to Left and Right brain hemisphere respectively, explained in Factory Management I lecture:

<https://archive.org/details/FactoryManagement1TheCorporateConstitutionAndManagementFramework>
<https://archive.org/details/GestinDeFFbrica1>

Videos: eeOS

How to build the enterprise excellence Operating System: <https://www.youtube.com/watch?v=CFoQoBkBiV4>.

Cómo construir el Sistema Operativo de la empresa excelente: <https://www.youtube.com/watch?v=GtxlRtjsQ9s>

Books:

The System of Excellence: <https://www.amazon.com/dp/B077SGKSB1>.

El Sistema de la Excelencia: <https://www.amazon.es/dp/B0744PTWF4>

How can we cope with in such hectic circumstances? ...In such an era, we have no choice but to jointly create and accumulate what we can trust and believe, and what we really want to protect. Instead of protecting the traditional corporate form, we will create a form of labor that can be serious. One of important form is to coexist with nature, society and people. We have to interact with people to create a new common world. Of course, how to maintain contact with people must be carefully considered. But our spirit can't be shut up. Rather than shutting down in an attempt to protect the existing society, we step forward to introduce a new society.

What is needed now is the above kind of spirit.

B. Troubles & problems

How we can promote **Kaizen**? ...New idea of **Kaizen** is the implementation of awareness which is able to be perceived in **Rightware**. And it is not possible to bring up the sensitivity in no visiting **Gemba**. And it is the meaning of deterioration of **Kaizen** mind. Meeting in telework and isolated work become popular. But (for instance) a meeting requires to create a various opinion. Then telework meeting is required the methods to complement this deficiency. The opportunity of making idle talk will decrease. Of course, PC has the function of Chat. But it is required to make face-to-face chat. Idle talk is one of vitamin for job.

I have written in Factory Management-1 about the importance of using **Rightware** for the job.

Now telework is one of big trend. And it promotes the job style which can be done anywhere with minimum condition (circumstances of ICT). And it can give the opportunity of bringing up **Rightware**, if it is possible to choose the suitable place (such beautiful countryside). On the other hand, unfortunately homeworking and isolated working style will increase. And in these cases, telework may be the cause of disturbing Gemba Kaizen.

A Psychiatrist sounds the alarm on home telework about the mentality equilibrium sense

C. World chaos

This COVID pandemic has the power of causing the chaotic world of century. And this disclosed (or now still is disclosing) the social contradictions which are social disparity, income inequality, gap between rich and poor, racism, ego of the large countries, reaction of globalism & populism, domestic first principal, exclusionism. These were covered when the economy was well by it. But when the economy was destroyed in the world, potential inconvenient truths were revealed.

We are in an era where we do not know what will happen and how we will develop. New viruses may occur repeatedly. And the second wave of COVID might be stronger and danger than first.



Ego of large countries

At present (unfortunately) the situation is no world leader. For instance, G7 or G20 fell into a dysfunction. While the no world leader will progress in the future, there is no doubt that international cooperation will be weakened and geopolitical conflicts will increase.

And the first problem facing the international community is the gap widening (gap between rich and poor, social gap, racism). Many workers and middle classes will explode their anger to the governments and leaders. The economy is shifting from physical store sales and the real economy to virtual and digital, and many unresponsive workers will lose their jobs.



US- China conflict

In the geopolitical conflict, the most concerned is the conflict between the US and China.

Unfortunately, US failed the initial response to COVID and searching the excuse to China. And the division of supply chain will be accelerated. Enclosure of the supply chain of allies unit will be progressed. In other words, each country's strategic priorities and global supply chains will become more locally rooted, changing the flow of globalization. An immediate concern is the development of Vaccine and supply. At present more than 140 of vaccine development plans are being progressed by countries with no corporation. Moreover, WHO might be fell into dysfunction. And the problem called "vaccine nationalism" might be occurred.

D. An eerie era

Why does this pandemic cause the worldwide panic, tension and economical and social chaos? ...It is fear.

Now from where a fear does come? ...A fear comes from 3 elements and these synergistic effects.

One is the actual harm (death): As I wrote before I felt my feeling of Memento Mori. A popular actors and actress died with the Cytokine storm (Immune runaway). And, we saw many cases of medical collapse. And, no one will be afraid if there is no such person.

Other one is the unpredictability: The new coronavirus has a great characteristic that it can be transmitted by asymptomatic infected people. And most of the people don't know if they are transmitted. They don't know if it will be transmitted to other persons. We can't predict. Some people are asymptomatic, and even if they finish without symptoms, there is a fear of Cytokine storm that some people become so serious that they die within 10 days.

Into where are we? ...Are Tokyo or Beijing in 2nd wave? ...What is next? ...May the second wave be changed and stronger? ...The victims are increasing in South America and Africa.

And last one is the control inability: When can we gain effective vaccines? ...Currently, research on therapeutic drugs in existing medicines is underway. However, there is no specific curatives, and also it is said that it will take at least a year to develop a vaccine.

What this means is that there is no way to control the symptoms. In other words, it fulfils the fear-causing condition of "uncontrollability". Even US & Europa cannot control it.

A fear is possible to express as next:

$$\text{Fear} = \text{Actual harm} \times \text{Unpredictability} \times \text{Control inability}$$

The characteristic of COVID shows that it is causing fear to people because it is an unknown virus that is very unpredictable and uncontrollable.

A President has told to his people that this (COVID-19) is just an influenza and no necessary to fear so much. And when considering calmly, every year 250~600 thousand people died with influenza. At first glance, his assertion is correct. Of course, it is wrong, even though there is a past data (which are the results of 250~600 thousand victims.). He believed that this COVID also same as past influenzas.

We learn from the past. And we call such attitude as scientific. A science is based on learning from the past. A scientist is the expert of past, but not future and unpredicted thing and a science is weak against inexperienced disaster.

Therefore, we need to take the attitude of "fear correctly".



Fear correctly

Having scientific and humble eyes and making effort to investigate unknown disease. But experts are not "experts of future".

A time to be difficult to anticipate damage.

Setting aside the assumptions from the past. Therefore, maximum action quickly. Consequently, don't be afraid to the over action.

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III. Control of lubricating oil.

A. Machine & Equipment Management

Again, TPM is one part of Machine & Equipment Management.

The region of Machine & Equipment Management is a little wide and includes Production planning, Safety, Workability (including the surrounding circumstances), Law, IoT, Total Production flow, Energy, Quality & reliability, Contamination prevention (including hazards waste), Environmental hygiene, Disaster prevention, Skill control, Standardization and Machine constitution (including Peripheral device & equipment), its construction (including spare parts) and TPM.

B. What is the purpose of TPM?

Long days ago, and at least before the collapse of Japanese Bubble- Economy (1986~ 1991) a word was a mainstream in Japan.

The word is "*Scrap and Build* (Japanglish; Japanese English)"

"The original meaning of Scrap and Build is 'Achieve high efficiency of production facilities by replacing old production facilities with new facilities by abolishing old and inefficient factory facilities' ."

Wikipedia

Then the trend of production Gemba was to dispose (a little) old type machine and replace to new. And production engineer sought new machines in collected catalogues and competed to buy. And production engineer misunderstood his job and became a (so called) catalogue engineer.

In that trend, a company took (and is taking) a different way which giving importance to using old type machines with well maintenance and Kaizen. The company is Toyota.

As I wrote in Making Stream of Production³, Toyota almost makes his machines by himself and continuing to give **Kaizen** and well maintenance.

Now that the bubble economy has collapsed and the economy has transitioned to a low-growth economy, we have changed from the era of disposable equipment to the era of how well we maintain existing equipment and continue production.

Machine & Equipment Management is "management to efficiently utilize the functions and performance of the facility from the planning of the facility installation to operation, maintenance, and disposal."

Its region is Whole life of machine & equipment.

³ **Making the stream of production:**

English: https://archive.org/details/makingstreamofproduction13_202001/mode/2up

Spanish: https://archive.org/details/establecerlacorrientedeproduccion13_202001

C. Maintenance tribology

By the way, I wrote before that it is said that 60% occurrence of failures in moving parts of machine are caused of the problems of lubricants (including lubricant supply).

And when looking the machine failure in overall machine, more than 25% number occurred, more than 27% of machine stop and more than 30% of loss amount are caused of lubricant troubles.

Then the lubricant oil control is very important and essential factor of Preventive Maintenance.

Now recent year the word of maintenance tribology is becoming popular for preventive maintenance.

What is maintenance tribology? ...I think that there are many people who do not really hear maintenance tribology, but if tribology is replaced by "lubrication and friction", it may easy to understand.

Maintenance tribology is basically a combination of maintenance and lubrication, but more than just a combination.

The two main points of the concept of maintenance tribology are as follows:

- One of them is that it is based on reliability engineering. It is an important element in maintenance tribology to develop logical maintenance based on reliability engineering, rather than performing maintenance indiscriminately.
- The second way of thinking is to make effective use of tribology for maintenance.

Tribology is a powerful tool for maintenance, but at the moment it is hard to say that the results of tribology are being effectively utilized for maintenance.

The most important part of maintenance tribology is activities to effectively utilize the results of tribology for maintenance.

As mentioned earlier, it is easily imagined that the use of tribology (lubrication technology to friction) reduces maintenance costs due to the fact that lubrication problems account for 25% or more of all problems (60% of failures that occur in the moving parts of machine tools).



Tribology

Again, when looking a book of Machine & Equipment Maintenance, sometimes we can see the word of "Tribology"⁴.

When I was young, there wasn't this word. But at present this word is used very naturally. I think you may know it. But just to be sure:

"Tribology is a field of science and technology about contact surfaces that interact with each other when two objects move relative to each other so that they slide with each other, and related practical problems".

⁴ <https://en.wikipedia.org/wiki/Tribology>

Fifty years of tribology: <http://www.eng.cam.ac.uk/news/fifty-years-tribology>

Wikipedia

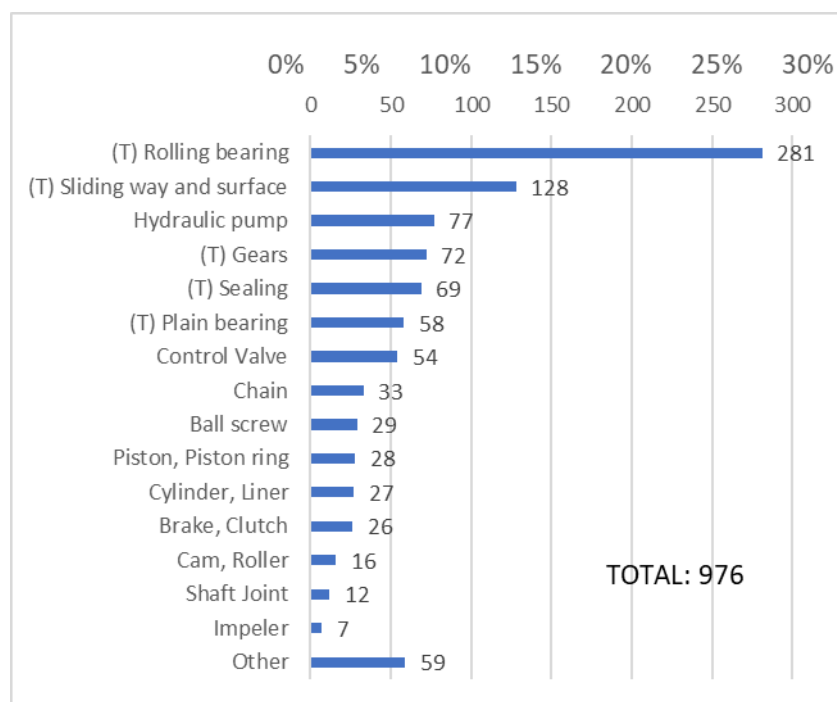
The origin is *τριβω*, which means “rubbing” in Greek. Arnold J. Sommerfeld (German physicist), the creator of fluid lubrication theory, presented important research in its early days.

The term was proposed in a report (Jost Report by Peter Jost⁵) that estimated damage due to friction and wear, which was later compiled in the UK in 1966, which prompted development.

People involved in tribology are called “Tribologists”.

D. Damage to machine

The next graph is about an investigation result of damage to machine & equipment. Please look at next graph:



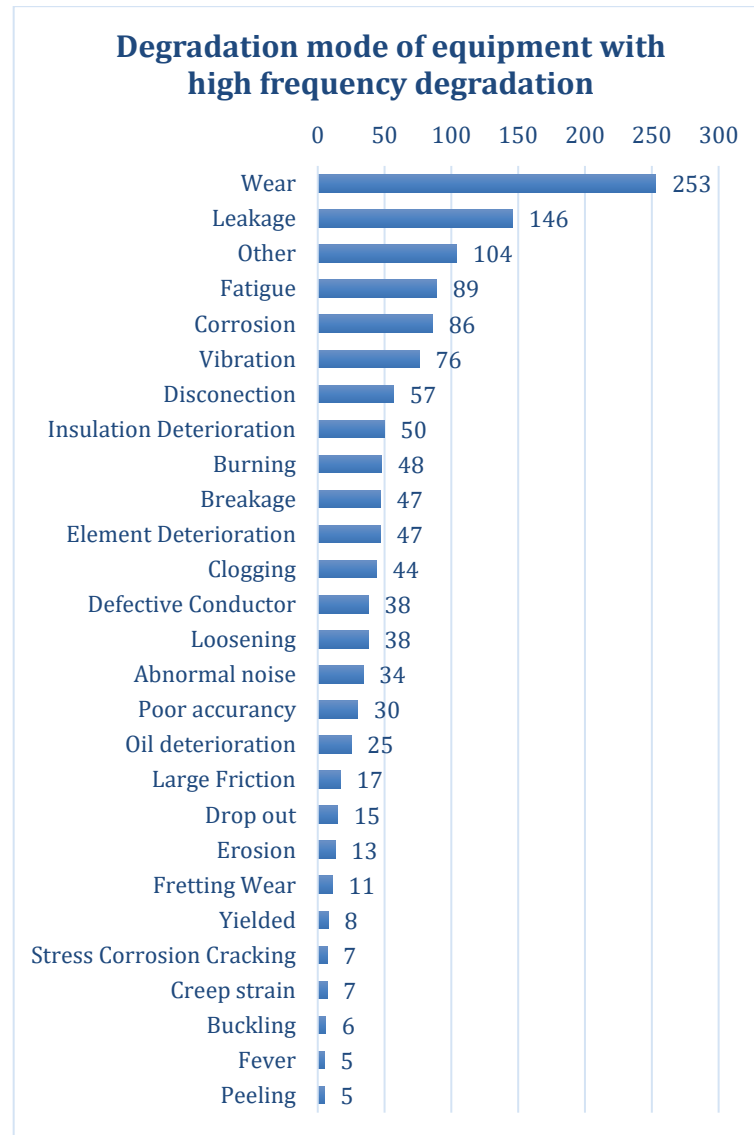
Firstly, the damage place.

Looking at the proportion of mechanical elements that actually suffered damage, as shown in above Figure, mechanical elements closely related to tribology, such as rolling bearings, guide surfaces / sliding surfaces, gears, seals, and sliding bearings, are ranked high. These elements are called triboelements (T).

And next Fig. shows the results of a survey on what kind of damage occurs to mechanical equipment.

Also, next graph shows the Degradation mode of equipment with high frequency of degradation.

⁵ https://en.wikipedia.org/wiki/Peter_Jost



As you can see that these types of damage are called degradation modes. Of the deterioration modes that occur in mechanical equipment, wear, leakage, fatigue, oil deterioration, and other modes that are very closely related to tribology are ranked high, and tribology has a very deep relationship to damage to mechanical equipment.

Considering that maintenance has a main theme of delaying the occurrence and growth of damage to mechanical equipment, from this, it is clear that tribology has a close relationship with maintenance, and maintenance cannot be discussed without tribology.

I would pick-up Maintenance Tribology later and now I wish to complete the theme of "Control of lubricant oil" which is one of essential theme of Maintenance Tribology.\



Control of lubricant oil

Again, what Lubricant Oil Control is. As I described in TPM-10, there are 6 points:

- 1) According to the application.
- 2) Use clean and correct lubricating oil.

- 3) Oiling into mouth decided.
- 4) at the timing decided.
- 5) Just quantity decided.
- 6) Onto friction surface certainly.

Let's look at one by one.

- 1) According to the application;
&
- 2) Use clean and correct lubricating oil; ... I introduced next table:

Lubrication Oil (From the Website of Japanese Lubricating Oil Company)	
Type	Purpose
Spindle Oil	<i>Spindle oil is generally used in high speed rotating parts such as light load machines, small electric motors, and spinning machines. The characteristic oil is that it has low viscosity and low load.</i>
Dynamo Oil	<i>Spindle oil Dynamo oil is mainly used for large motors, generators, blowers and ventilators that rotate at high speed.</i>
Turbine Oil	<i>Used for lubrication of high-speed bearing parts of various turbines. It is also used for lubrication of hydraulically operated parts of various machines such as compressors. There are two types of turbine oil: non added turbine oil and added turbine oil. Unadded turbine oil is characterized by excellent water separation. On the other hand, added turbine oil is characterized by its excellent oxidation stability, de properties, rust prevention and water separation.</i>
Machine Oil	<i>Machine oils are widely used among lubricating oils and are characterized by that they contain no additives. Generally used as lubricating oil for bearing rotating friction parts of various machines. One of the features is that the varies depending on the type of crude oil. Lubricants are classified into normal grade lubricants.</i>
Cylinder Oil	<i>Cylinder oil is mainly used for cylinders and valves of steam engines. Cylinder oil has a high viscosity and is used as an oil for parts with high temperatures and loads.</i>
Gear Oil	<i>Gear oils are mainly used in various gears as lubricants for reducing friction and cooling of reduction gears such as general machinery and rolling mills. There is a type with an extreme pressure agent added and a type with no additive. Extreme pressure agent added type is added with abrasion resistance and seizure resistance. On the other hand, the characteristics of the extreme pressure agent free type are excellent in oxidation stability, water separation, defoaming and rust prevention.</i>
Bearing Oil	<i>As the name implies. bearing oil is used for lubricating the bearings of machines. Has /rust prevention properties that prevent rust.</i>
Compressor Oil	<i>Compressor oil is used for lubrication of compressor cylinders and bearings. Types a divided into reciprocating type and screw type. It is characterized by extremely low carbon generation and excellent oxidation stability and rust prevention. The screw type is also characterized by excellent oxidation stability, rust prevention and water separation</i>
Sliding Surface Oil	<i>Sliding surface oil is commonly used to lubricate sliding guideways on machine tool the types of sliding surface oil are classified into those that are dedicated to guideway and those that are also used as hydraulic oil. It features excellent resistance t vibration phenomena generated on the sliding surface. rust prevention, and oxidation stability.</i>
Refrigerator Machine Oil	<i>Refrigerator oil is mainly used for lubrication of refrigerators. When mineral oil-based lubricating oil is cooled, the minimum temperature at which it flows is low. So, it is characterized by good stability to refrigerants such as ammonia. Refrigerator oils are divided into mineral oils and synthetic oils such as alkylbenzenes.</i>
Hydraulic Oil	<i>The hydraulic oil is based on turbine oil and contains additives. It is used as hydraulic oil for hydraulic media and hydraulic pumps. Generally, hydraulic oils are characterized by low viscosity. It is also characterized by excellent oxidation stability, water separation, defoaming, and rust prevention. In addition, there are types that exhibit viscosity. temperature characteristics. wear resistance. fire resistance. etc., so</i>

	<i>they can be used properly depending on the type of hydraulic pump and operating conditions. The types of hydraulic oils include general hydraulic oils of the R & O type. low pour point oils with high viscosity index. wear resistant fluids, and flame-retardant oils</i>
--	---

3) Oiling into mouth decided;

Omit. Please, look at the instruction manual.

4) At the timing decided.

It is important to share when "when necessary", but for that purpose it is necessary to set the oiling cycle.

Normally, it should be set it by referring to the instruction manual, but if it is not listed in the instruction manual, it should be reasonably decided the standard and then decided by trial and error. In that case, I think it is better to set it while checking the condition of the oil film of the lubricating oil. In this case, setting a little shorter than the possible cycle and gradually lengthening this cycle will prevent the risk of "out of oil".

Of course, timely oiling not only involves deciding the cycle and supplying the lubricating oil at that time, but "it is necessary to reliably perform oiling and inspection at the beginning of every day."

And it is required to implement the "scientific experience".

5) Just quantity decided.

Suitable amount of lubricant supply is required. Because too much or too little oil quantity can cause poor lubrication.

- **If too much:** This may cause oil leakage, or depending on the lubrication method, the deterioration of oil may lead to a decrease in viscosity and cause poor lubrication.
- **If too little:** An oil film will not be formed on the friction surface, causing "galling" or "burning".

The appropriate amount of lubrication is determined according to the sliding parts, rotating parts of the equipment, movement conditions and lubrication method.

Determined!? ...Determined in the instruction manual? ...No, I haven't seen such convenient description in it.

Unfortunately, it is necessary to determine by yourself even though such data is in the instruction manual.



Circulation lubrication and Total loss lubrication

The lubrication method varies greatly depending on whether circulation is to reduce friction or wear or lubrication for cooling.

In the case of "Total loss type" lubrication, it is sufficient to supply the amount of supply necessary for optimal lubrication activity, and in the case of the "Circulation type", it is sufficient to supply the amount of lubrication based on the cooling effect.

Now in here I describe the case of **"Total loss lubrication"**.

How to decide the suitable quantity? ...The formula for the amount of lubrication is shown below for reference. The calculation formula differs depending on the type of lubrication point, so use the appropriate calculation formula. However, It is impossible to accurately obtain the required amount of lubrication with using the calculation formula.

This is because of depending on various conditions such as bearing material, surface roughness, rotation speed, load, operating conditions, ambient temperature, and type of lubricating oil, seal condition, new machine, or machine used.









Then finally you need to decide it based on scientific experience (try and investigation and record)

The *"Management Guide for Lubrication"* published by the Japan Management Association is defined as follows.

"If you give the necessary oil film between the two sliding surfaces first, then you can replenish the amount of leakage from the shaft end to obtain good lubrication performance."

It recommends to *"determine the required amount of lubrication in advance using a calculation formula and determine the amount of lubrication with reference to the amount and experience values after machine trial operation"*.

Now calculation formula. It is for your reference:

Supply point		Formula
Anti friction bearing		$Q = 0,1/25,4 \times \text{bearing diameter} \times \text{number of rows} \times K$
Plain bearing		$Q = 0,15/25.42 \times \text{rotating shaft diameter} \times \text{bearing length} \times K$
Plane lubrication		$Q = 0,01/25.42 \times \text{length} \times \text{width} \times K$
Cylindrical lubrication surface		$Q = 0,15/25.42 \times \text{diameter} \times \text{length} \times K$
Chain		$Q = 0,01/25.42 \times \text{length} \times \text{width} \times K$
Ball bearing way		$Q = 0,03/25.4 \times \text{length} \times \text{row} \times K$
Gear		$Q = 0,3/25.42 \times \text{pitch diameter} \times \text{tooth surface width} \times K$
Cam		$Q = 0,08/25.42 \times \text{contact circumference} \times \text{width} \times K$

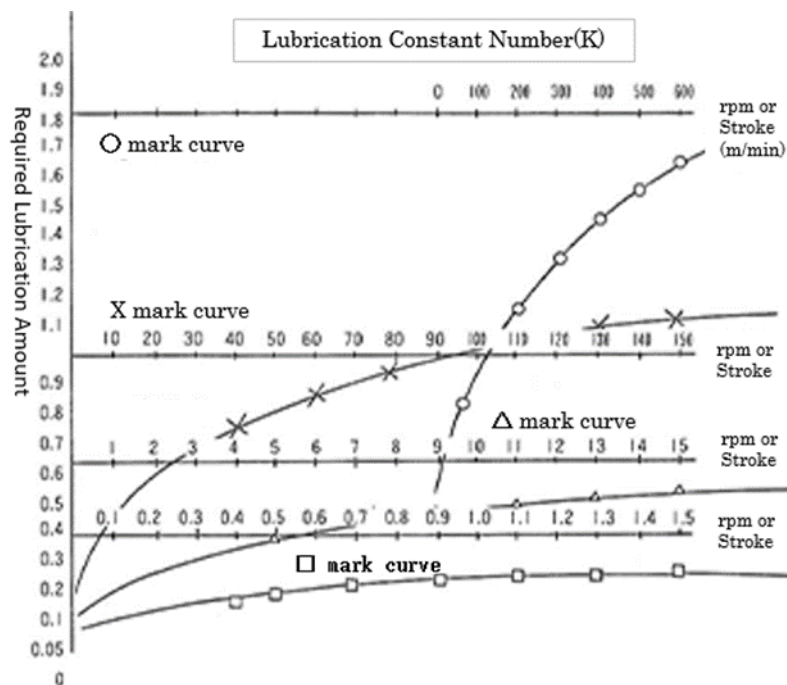
Antifriction bearing = Number of rows = ball, roller or needle bearings

Plan lubrication = Length includes stroke length

Q = Required lubrication ammount $\frac{cm^3}{hour}$

K = Lubrication constant number (see graph)

Diameter, Lenght and With unit in **mm**



The constant is doubled for every 10 times speed increase rate⁶.

Again, the important things are to gain the scientific experience and decide the suitable standard for both Timing and Supply amount".

6) Onto friction surface certainly.

Omit...

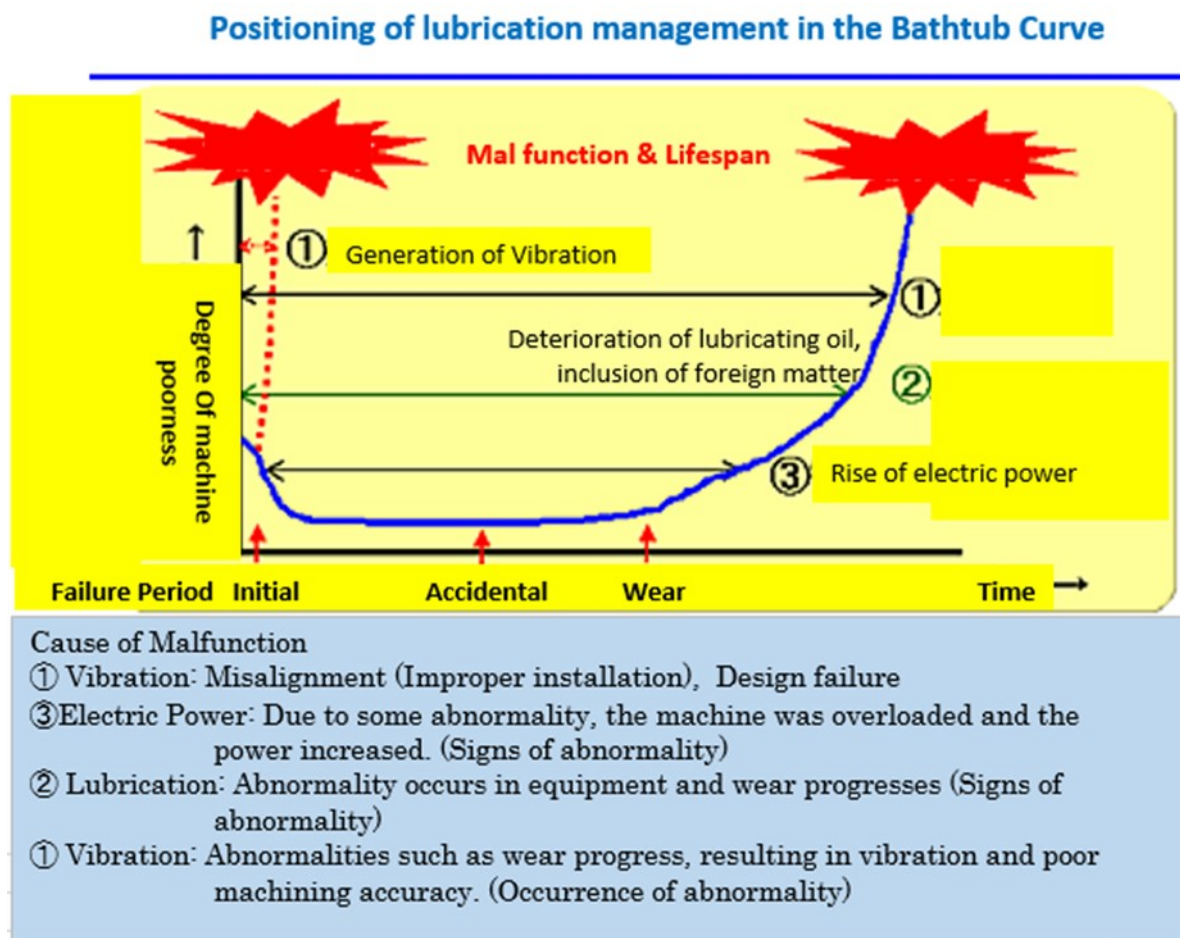
⁶ Graph, tables and formulas from the "**Guide for Lubrication Management**" published by Japan Management Association": <https://www.jma.or.jp/en/>

IV. Whole life of machine & equipment

By the way, I wrote the word of "Whole life of machine & equipment" in before page and said that the region of Machine & Equipment Management is from the planning of the facility installation to operation, maintenance, and disposal.

And when looking at the whole life from TPM, the famous Bus tub Curve would be helpful.

Please look at next picture.



There are THREE failure periods which are Initial Failure Period, Accidental Failure Period and Wear Failure Period. And as you understand, the failure rate tends to increase in "Wear Failure Period"

Obviously, if the machine runs for a long time, internal parts will start to wear and fatigue. The period when failures increase due to the life of the machine is called "Wear Failure Period".

And before this period comes, we must make efforts to extend the "Accidental Failure Period" in which operation is stable by exchanging the expendable parts and maintaining.

Whether the time for failure due to deterioration or wear of parts comes earlier or later depends on how the machine is used.

How to delay this failure period is a showcase for the technicians who perform maintenance, so periodic inspections are essential tasks.

And, most important factor is lubricating oil control.

I would write this theme including Tribology a little more in next description.

V. Teaching the company

I'm writing one case of a middle-class industrial company. And with through this case, I write my method of new system introduction & stability.

This company wished to improve (reduce) production cost for recovering profit and ROE. But this company (he) took strange direction.

His wishes were to recover the profit. And he knew the necessity of sales expansion, and wished it. Then he wished the cost reduction of production Gemba.

He believed the importance of QCD (Quality, Cost and Delivery).

Quality? ...Yes, it is essential, but is very basic condition for a business. And, the quality issue was covered with heavy quality assurance tactics. However of course it was never sufficient to the survival of this company.

Delivery? ...He covered this issue with having heavy inventory, which caused the excess and obsolescence material and products and dispose losses.

Another one of concern was his market position. His market position (share) of relevant products were fourth or lower.

Quality is of course important. However, it is very natural thing to make business nowadays and even though it was improved, it might not be affected to the future growth.

To keep the customers order, his measures was the quick response of delivery, based on the heavy inventory.

A. Something strange.

When I joined to this company, I felt something strange:

- 1) His target was to recover the profit. But he desired the introduction of JIPM's TPM
- 2) Not possible to feel the enthusiasm in Gemba.
- 3) Many Mudas in process. (Such re-inspection by inspectors, excess or obsolete materials & finished goods.)
- 4) I hadn't seen the face of the president in this plant. (There were some photos.)
- 5) There is no middle and long-term plan.
- 6) Strange annual profit plan.
- 7) Outsourcing policy.

I explain one by one.



1) His target was to recover the profit and sales expansion based on the cost competitiveness.

But he desired the introduction of JIPM's TPM. Why TPM? ...He had known the corporate problems which were not only the production cost, but also the sales growth. But he wished to introduce JIPM's TPM.

Therefore, when I made a session with the directors, their requirement was just the TPM introduction. They believed that with introducing JIPM's TPM, it is possible to reduce cost. And initially I imagined that many losses which were losses of material, labour and LT (lead time) caused machine troubles. But...

When looking around the factories, I could understand the causes of high cost which were mainly not caused machine troubles. And, I suggested that TPM introduction and stability are good thing. However, the introduction of TPM is not affect to cost reduction. But they insisted to the introduction stubbornly.

It was indeed strange thing for me. And, I wrote that if desiring true cost reduction, it was necessary to resolve following things:

- Reduction of material loss (in Quality cost.)
- Reform of production plan (JIT concept and eliminate excess & obsolescence)
Then...
- The project team suggested the TPM introduction concept as "JIT machine condition".

But with just above items, it wasn't possible to resolve the illness of this company which was cycle of High Price and No Sales Growth (or Sales Decrease) caused of High Cost Constitution, Excess Inventory (for keeping competitiveness) also poor TQM then gain High Cost (because of Material loss and quality cost increase).

Unfortunately, I promised to help this company, although it was under the effect of the drink.

Japanese saying that: "*A samurai's word is as good as his bond*". Then, I suggested the introduction of TQM after the introduction of TPM and suitable timing.

Now, with just above problems and solving, is it possible to reduce cost? ...No. It is not sufficient.



2) Not possible to feel the enthusiasm in Gemba.

There were some causes... Of course, one of cause was the initial stage and failed to move to actual practice after the stage of planning. But the reason was not just this.

By the way, are employees just the tool of getting profit? ...It is correct if we were in the age of the is "*Modern Times*"⁷ by Sir Charles Chaplin. This was accepted as the voice of management side. And, a company is important tool for just earning cost of living. But it is also correct, even today.

This is accepted as the voice of employee side. But In the generation of Millennial and AI, the employee's mind for work is changing.

⁷ Modern Times: [https://en.wikipedia.org/wiki/Modern_Times_\(film\)](https://en.wikipedia.org/wiki/Modern_Times_(film))

Then it is not possible to consider corporate management without "employee engagement".



3) Many Mudass in process. (Such re-inspection by inspectors, excess or obsolete materials & finished goods.)

I listed up this "Many Mudass in process". And although there is a difference of degree, it is, unfortunately, quite natural thing in the world.

Unfortunately, this company mistook the direction to resolve the high cost constitution. And... This mistake was just his company's responsibility? ...Yes. It was the responsibility of top management, particularly the president. A company directed by incompetent president ruins.

But a salvation for this company was the management team who negotiated the direction to this president. They had normal mind.



4) I hadn't seen the face of this president.

According to the directors he doesn't reside and come to this plant normally. And he doesn't attend the making of middle & long-term plan and annual profit plan, and just giving profit target and authorization.

Middle & long-term plan are not made annually. But it is required to review and the correction. But he doesn't attend to this important event.

A director told me: "Our company doesn't give the importance to such middle & long-term plan".

Because, nowadays it is the age of speed and the business environment is changing so rapidly. Therefore, it is no meanings to bother to make such plan.

I was surprised by the director's comment. This company is middle class scale company with number of employees and sales amount. But even though it is a middle-class scale company, this company hadn't understood the meaning and importance of Middle & Long-term plans.



5) Middle & Long-Term plans.



Long term strategy.

In Factory Management-2, I have introduced the case of my previous company, SUMITOMO Wiring Systems. The long-term strategy (plan) was Strategy of Vision "12".

And the contents were: "We made the strategy of vision "12" at the year 2008 that is to realize the goal until 2012 and the goal is: (1) Consolidated sales: 6,000 million (us dollar.) per year. (2) Global market share: 25%.

After this SUMITOMO made next long-term strategy "Vision- II to improve QCDDM (Quality, Cost, Delivery, Development and Management).

And now, He made long term plan (strategy) "22V-Reduction25". (I omit the detail contents).

Therefore... I was stunned by his words.

Annual management plan (Profit plan)

The important job role of president is to make a corporate management plans which are middle & long-term plan and annual profit (management) plan.

And he must explain his will to all employees (and for instance bank) with papers and words. It is quite important event to appeal his strong will and requiring the all employee's cooperation.

He escapes from his most important job role which is to take his spearheading to make such planning and appeal.

Making or reviewing & correcting Middle & Long-term plan is important for not only a big and medium scale companies, but also for small scale companies. It is quite true that the business environment & condition is changing rapidly. It is never exaggerated to say that it is not possible to predict one year later, much more not possible to predict 3 years, 5 years later. For instance, in the past there was worldwide trouble which is Lehman Bros Bankruptcy at 2008. Lately there were Brexit, deserter of climate change and US-China trade friction. And now COVID-19 is attacking worldwide economy. We know very well that "No one knows what the future holds". But still making long & middle term plan is important for a company.

These are the compass of company's future growth. And annual corporate management plan which is made with current market situation, reviewed middle & long-term plan is concrete strategy. And, after making this annual management plan, the president needs to explain to all employees (and sometimes relevant bank) with his own words directly.

The timing of direct speech by president is the beginning of work of the New Year also in the company newsletter. My previous company has many branches and plants in the world. Therefore, the direct speech is made with video message. Anyway, the job role of president is important.

In this company, the president neglects such important planning and also the event.

Thus, in such situation, it is understandable that so low motivation of employees. Moreover, this company failed the initial TPM introduction activity and lost half year. But not only this thing, but also the lack of president's job role affected to the employee's moral.

Then, I lectured to the directors.

Please make long & middle term plan.

It is quite true that the changing business environment is rapid. And, of course, it happens the difference and sometimes big differences. However, the occurrence of difference is important.

The plan is the scenario of gaining profit and expanding business.

Is the important thing to review why the difference occurred? ...Then it is possible to improve the skill of making plan with forecast.



6) Strange annual profit plan...

B. Cost reduction for this company.

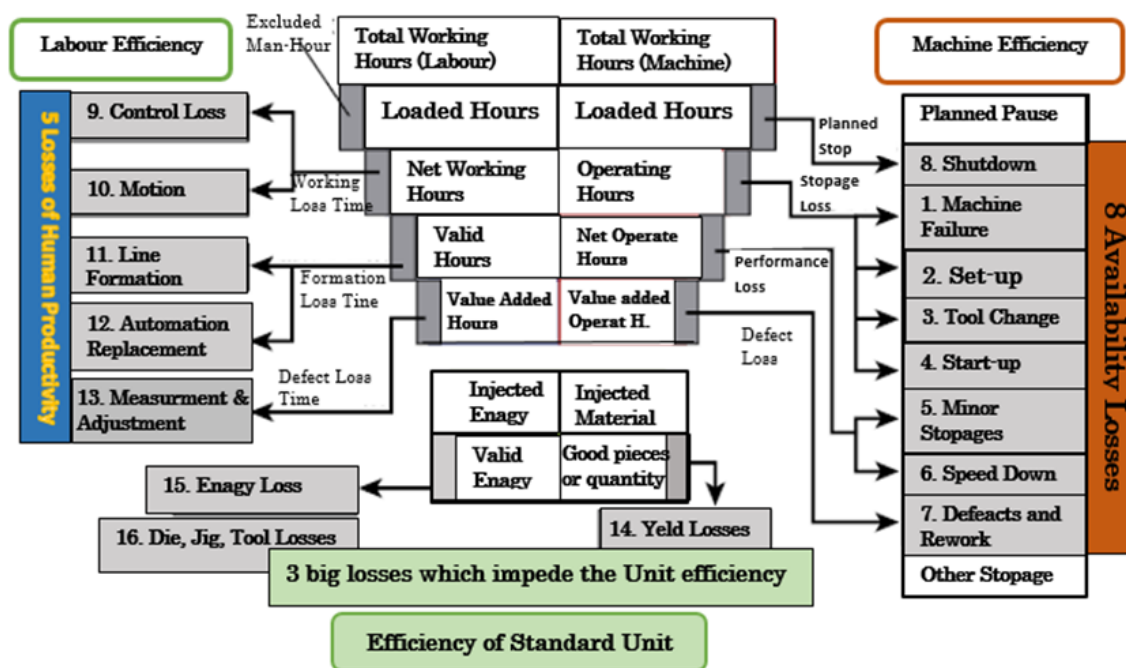
I described the high cost constitution of this company and also the bad cycle. And it (TPM introduction) was not sufficient for his desire.

Again, his desire was

- 1) Cost reduction in production process.
- 2) Improvement of corporate constitution⁸.
- 3) TPM introduction (but as the means of above propositions)

Why he wished such things. As you remember the president wished to recover the profit and ROE. And he discussed with his friend consultant. Then he decided to introduce JIPM's TPM. He believed that it is possible to reduce cost with JIPM's TPM. Now we need to have doubts about 2 things.

Firstly, please look at next familiar figure. It is good and I like this JIPM's figure which shows the 16 kinds of losses in production Gemba and use it quite often.



⁸ El Sistema de la Excelencia (Español): <https://www.amazon.com/dp/1521901864>

The System of Excellence (English): <https://www.amazon.com/dp/1973409771>

Factory Management I: Español: <https://archive.org/details/GestinDeFFbrica1>

English:

<https://archive.org/details/FactoryManagement1TheCorporateConstitutionAndManagementFramework>

Factory Management II: Español:

<https://archive.org/details/GestinDeFFbrica2ElDespliegueYElControlDeLaPoloticaCorporativa1.5>

English: <https://archive.org/details/FactoryManagement2PolicyDeploymentControl>

Factory Management: III: Español:

<https://archive.org/details/GestinDeFFbrica3LaDeclaracnDeLaPolPticaYLaVision/mode/2up>

English: <https://archive.org/details/FactoryManagement3PolicyStatementAndVision>

This figure shows the Mudas in 3 parts. These are Mudas of Machine, Mudas of labour and Mudas of Energy and Material.

- A. One is that is it possible to reduce production cost with elimination of Muda in machine process?
- B. Another one is that is it possible to improve profit with above cost reduction?



7) Outsourcing policy.

That day the director visited my hotel with the sales department director and invite me to drink in the hotel bar.

Then I guessed his tactic that there must be something consultation and I whispered in my mind that I'm not going to fall for his trick and invited them to take coffee in a lounge and told them: —I'm sorry I cannot drink tonight because of my health regulation —and it is true that I stop drinking every 3 days. And this day was the day of regulation.

In this way, we sat down in a sofa of lounge and ordered coffees.

Then, the director began the talking. It was indeed they were in sever trouble about: Project continuation, Sales expansion, Prospect of profit recovery...

— Sensei, how can we do? —the director ask me.

— How can you do? — then I answered— I don't know and it is not my matter. The contract of my consulting job is just TPM introduction and its stability —I responded just a little maliciously.

— Please listen and please accept to change the contract —beg the director—. As you said our contract is just TPM introduction. But unfortunately, as you told us just introduction of JIPM's TPM is not enough to recover the profit moreover expansion of sales amount.

— You suggested us to introduce TQM to resolve the quality issue and the stability of TPM. —continued the director—. But still it is not sufficient for our aim. We are in trouble. It is very serious.

— If there is no increase of sales, as you said, no increase of labour efficiency and machine cost reduction. And if dismiss excessive labours, the project might be collapsed and we cannot expect an establishment of any project —he ended.

— You could recognize that just TPM, even though JIPM's, introduction doesn't affect sufficiently to your aim —I said—. To recover profit, it is important and essential to eliminate Muda in process.

— However, you need to understand that there are 2 cases that Muda reduction relates to cost reduction and doesn't relates to it —and I detailed both of ones—. The case of material scrap reduction and defect reduction affect cost reduction.

— But even though labour and machine efficiency are increased, there are not related to cost reduction. And —I continued—, if I wish to contribute to cost reduction with these, it is required to reduce labour and machine capacity which means the dismissal and deal of some machines.

— By the way, how was the meeting with your president? —I asked.

The conclusion of this meeting was as next: (From the description of TPM-10⁹)

- *Conclusion by chairperson (Director):*
 - *Continuation of this project.*
 - *No dismissal of Gemba employees. (No leak this discussion contents regarding the part of remark of dismissal to any persons including project members.)*
 - *"JIT Machine condition" concept is supported. But...*
 - *No excess machines are sold.*
 - *Sales (including price and quality) strategy is discussed urgently.*
- *The president mentioned a compromise which the dismissal implementation is given the grace period of 6 months.*
 - *During the 6 months, sales increase should be resulted.*
 - *The scale of sales increase should be more than the income amount by dismissal.*
 - *The sales amount increase activity should be implemented as companywide activity.*

Anyway, the dismissal was given the grace period.

This top decision wasn't opened to manager class and employees including project team and committee.

— It is impossible to expand sales amount within 6 months. It is indeed an "impossible mission" —said the director—. Thus, there is no way without dismissal of excessive labour capacity —and he continued...

— But if we do, it is the meaning of failure of the project again. And our one of aim which is to introduce TPM also will not succeed. —and then the director begged— Sensei we need your help. Are there methods to resolve these difficult missions which are Profit recovery, No dismissal for continuation of project and Sales growth?

— Before my suggestion, please let me know something —and I detailed—. When looking around your warehouse I saw many excess finished goods and goods of work-in-progress which have the name tags of other company. What are these? — And I asked another question without waiting for the answer— Another question is why you have so many surplus machines including forklifts?

— We have surplus machines as you pointed out —the director detailed—. The cause of these surplus is the outsourcing policy. About 3 years ago, we took the strategy of outsourcing because of the cost reduction strategy and also the countermeasure of internal overload.

— Initially —the director explained—, we produced our all products in our internal production line. But in the policy of cost reduction with using subcontract, some processes were transferred to the subcontract. In fact —the director recognized—, the use of subcontract is successful and we could reduce the cost. Also, we could resolve the problems of internal overload.

Then one of the subdirectors pointed out: — And we had begun the outsourcing of finished goods also. The inventories of finished goods are from the outsourcing.

I shown a surprise expression on my face listening that, and I questioned: —At present the overload issue is resolved because of sales reduction, even if producing all internally, isn't it? ...And, one more

⁹ TPM-10 - Employee engagement and oil control:

<https://archive.org/details/tpm10employeeengagementoilcontrol>

TPM-10 - Compromiso del trabajador y control de la lubricación:

<https://archive.org/details/tpm10elcompromisodeltrabajadoryelcontroldelalubricacion>

thing. Is the labour cost fixed cost or variable expenses (cost) for your company? Of course, fixed cost, am I right? —I asked.

— Of course, fixed cost without the expense of overtime work —answered the director.

— It is indeed your company is very strange —I shown my frustration—. You desire to reduce cost, but as the result create big Muda caused of the cost reduction activity. I said it is strange. But I need to paraphrase to "stupid".

— Your outsourcing policy made big mistake which doesn't realize cost reduction, but causes big Muda. Your cost reduction way is wrong!

The subdirector shown a surprise expression and then he asked: — But Sensei. We could realize the certain cost reduction. And if stopping the outsourcing policy, we cannot realize the price competitiveness. We buy and sell some products with using the subcontracts —the subdirector recognized.

— OK. I explain one by one. And the meaning of one by one is the case of outsourcing of production processes and outsourcing of finished goods (like as trading company) —I detailed.

— Firstly, please implement immediate action to stop outsourcing of production processes. These production processes can be produced internally, aren't these? — and the I asked again— You have workers and machines, haven't you? ...Of course, production support departments such HR, Accounting, Production engineers, Maintenance engineers, Quality, Warehouse etc. also are included in the workers.

— Now —I explained—, what is "Cost"? ...A cost is calculated as next: —And I write below down on the whiteboard at the time I speak: "*Cost = Fixed cost + Variable cost*" and I detailed each one.

— Fixed cost: Labour cost (Direct and Indirect), Head office, Depreciation of machine & equipment, land & building, payment of patent and interest and etc.

— Variable cost: Material, transportation cost, outsourcing cost and other cost variable related to sales amount.

— Subcontract also produces your products or work-in-progress with using fixed cost and variable cost. Now you understand, I think —and I tray to explain...

— There are big Muda in this production. These are duplicate fixed cost —and I detailed—: Outsourcing fixed cost plus internal fixed cost. And unfortunately, you cannot eliminate the internal fixed cost which is labours (direct and indirect) and excess machines. Also, there are some variable cost Mudas. For instance, transportation Muda...

— I confirm you. You cannot dismiss excess labours which are direct production workers and also supporting staffs (office workers, supervisors, material handlers.) And, you cannot deal with excess machines, because of the will of your president. —Then I asked— How can you eliminate these duplicate Fixed costs? ...The answer is to stop to use subcontract for supplement some processes.

One of the subdirectors answered: — Sir, if we stop to use outsourcing, the product's cost is increase. And, we cannot have the necessary cost competitiveness. It is quite clear that the cost of subcontract is cheaper than our internal production.

—OK —I tried to explain— Mr. Subdirector, please consider the next: Is it true that the cost submitted by subcontract is cheaper than internal production cost? —I asked figuratively—. You compare the internal cost which is calculated with the hourly rate and standard hours and Variable cost.

Then I written down on the whiteboard meantime I pointed out again: "*Cost = Variable cost + Hourly Rate x SH (Standard Hour of the product)* "

— And, the hourly rate is constituted of the fixed cost such labour cost, machine depreciation and head office expenses —I detailed—. This internal cost is in a sense provisional cost. And it is essential to see and calculate as companywide situation.

— On the other hand —I faced—, buying from subcontract is the external purchase cost and is variable cost. And basically, the calculation method is different. If you use an outsourcing company just because the internal cost is apparently high, you will not be able to secure enough profit to cover the internal fixed cost...

— This means that profits that would have been gained if done internally could not be obtained, and it is difficult to make a sufficient profit in this state —I concluded.

The subdirector shown an expression of surprise and doubt and then I tried to explain in a better way: — Mr. subdirector still you seem to be not to understand well. OK. Let's consider it from the point of view of Muda. — And I detailed— you pay to subcontract the money of subcontract's Fixed cost (such labour and machine) and Variable cost (Material, transportation cost) ...

— If you could produce same products with "0 Fixed cost", don't you think it is cheapest do you? ...Variable cost might be same even if using subcontract or internal process...

— And if you could produce with no cost of subcontract Fixed cost (even though the fixed cost of subcontract is cheaper than internal fixed cost which is unneglectable), it can be calculated as "profit" —I continued...

— You review the outsourcing policy immediately and return the production process of outsourcing. Above is we looked at from the point of view of Muda (duplicate fixed cost which are internal and, in the subcontract) ...

— You have workers (production and indirect) and machines (depreciation) and expense these costs. And, these internal fixed costs are not used. So —I concluded—, you have excess labour capacity and also machines.

— I think I could understand the duplicate fixed cost. But... —the subdirector continued trying to explain deeply despite his doubts in his assertion.

— Let's look at from the point of view of marginal profit. I believe you could understand "**Marginal profit** and **Break-even point**".

— Marginal profit... Now let's look at from different view point which is the Marginal Profit. As you know — I thought that they know— Marginal profits are calculated as next: —And I written down in the whiteboard again—

- *Marginal profit = Sales amount - Variable cost (expense)*
And,
- *Profit = Marginal profit - Fixed cost*

Then,

- *Marginal profit - Profit = Fixed cost.*

— In Japan marginal profit is called as Limit profit. Why so called? —I asked figuratively—...Even though at worst case, it must be required to cover and obtain the fixed cost in the sales. And, the case of *Profit = 0* is the case of *Marginal profit = Fixed cost*

— But it is not the worst case —I recognize—. There is a case to accept to receive order even though it is not possible to cover all fixed cost. Your outsourcing case is possible to calculate as next:

- *Marginal profit = Sales amount - variable cost (outsourcing)*

— It seems to be smaller than internal production. But actually, your situation is:

- *Profit = Sales amount - variable cost - internal Fixed cost.*

— And, your internal Fixed cost which are excess labours, excess machines support staffs & land & building etc. (allocated to the products) are very expensive —I continues...

— These expensive internal fixed costs can never be 0, even if these are not used for the products. No, it is possible to 0 amount. If you could reduce in dismissal and deal machines and shrink company scale. But not possible, isn't it?

The Subdirector doubted for a while and then, he asked me: — And Sensei, what is your suggestion?

— I conform you again —and I repeated again—. You cannot dismiss excess direct labour (production process worker), indirect labour (office staffs and Gemba such supervisor.) and reduce Head office expenses and depreciation of machine & equipment & building and rent expenses (These costs are allocated to the hourly rate).

— Your decision was not selling or treat excess machines, wasn't it? ...Also, you might not possible to make downsizing your company scale which meaning is to downsize your head office and lands, might not you? —I asked figuratively...

— In short, you cannot treat anything internally, can you? ...Then, the answer is just one. Undo the processes which you transferred to subcontract and the products which you can make in internal production line.

— I understand your saying —the director said—. I've learned TOC (Theory of Constraint). TOC teaches that the secret measures to gain profit is the maximizing Throughput. Sensei, your saying is TOC, isn't it?

I tried to show a compromised face but, in my heart, I felt it could be acceptable to gain their understanding with any idea. Throughput of TOC is almost same to Marginal profit —Well, yes —I said.



TOC and Throughput

You know the word of TOC and Throughput. This study says one important point which is the relation of "time concept with profit". For us (in the concept of TPS or factory management) it is quite natural thing.

For instance, gaining \$ 100 profit, one is to be needed 10 days from getting order and production plan, purchase materials production and delivery and getting cash, and another

one is to be needed one month (30days), which is better for a company? ...The cash flow is very much different.

In the thought of cash flow which is better internal production or outsourcing? ...Of course, internal production is better.

The case of outsourcing necessity is just next 3:

- a. To supplement the function being insufficient internally.
- b. Need equipment and technology not available in the company.
- c. To cover fluctuations in demand. Demand fluctuates greatly and fixed resources cannot be kept



Throughput

In somewhere, I have written this: "A scholar is such a person who write and present very natural thing in Gemba as if new discovery".

TOC advocate to maximize Marginal profit. And, according to a book, Throughput is explained as next.

$$\text{Throughput} = \text{Sales amount} - \text{True Variable Cost}$$

In the partial optimization, only the production efficiency of a certain process is improved, and as a result, the production capacity of the entire factory or the overall profit may not be achieved. Therefore, overall optimization is realized by aiming at maximizing the throughput. "True variable costs" are only variable costs such as raw materials and transportation costs, and do not include so-called factory costs such as depreciation costs, utilities costs, and labour costs included in costing. And, profitability is determined based on the throughput per unit time in the constraint process.

Why is such obviousness in the limelight? ...The job of a scholar is to identify the truth. And this advocate scholar did good job. However, it is too usual in Gemba. Therefore, I wrote the report of *Making stream of production*¹⁰. Why was it necessary to use such new words (Throughput) rather than the old word Marginal Profit?

Now, again Marginal Profit...

— I think you understand Marginal profit — I tried to explain —. For getting your better understanding, I give you another one of explain with using "Break-even point". I believe you know it. Yes? —I asked to them.

— Yes, we know it —the director confirmed.

¹⁰ Making the stream of production lectures by Sensei Koichi Kimura:

«ENGLISH» https://archive.org/details/makingstreamofproduction13_202001/mode/2up

«SPANISH» https://archive.org/details/establecerlacorrientedeproduccion13_202001

— But why don't you use it before continuing outsourcing policy? —I asked and also answered to myself— Let's look at it and I example the break-even point chart.



Break-even point

When you make a profit plan, the break-even point chart shows the relationship that "how much sales you make will generate a lot of profits. And, if you don't make at least this much sales you will be in the red."

— At this moment in time I have no exact figures of your sales and construction of cost. Therefore, please accept that my explanation is just image comparison

Then, I removed all my previous annotations on the whiteboard of the meeting room and, I start to draw the below figure about the Break-even point.

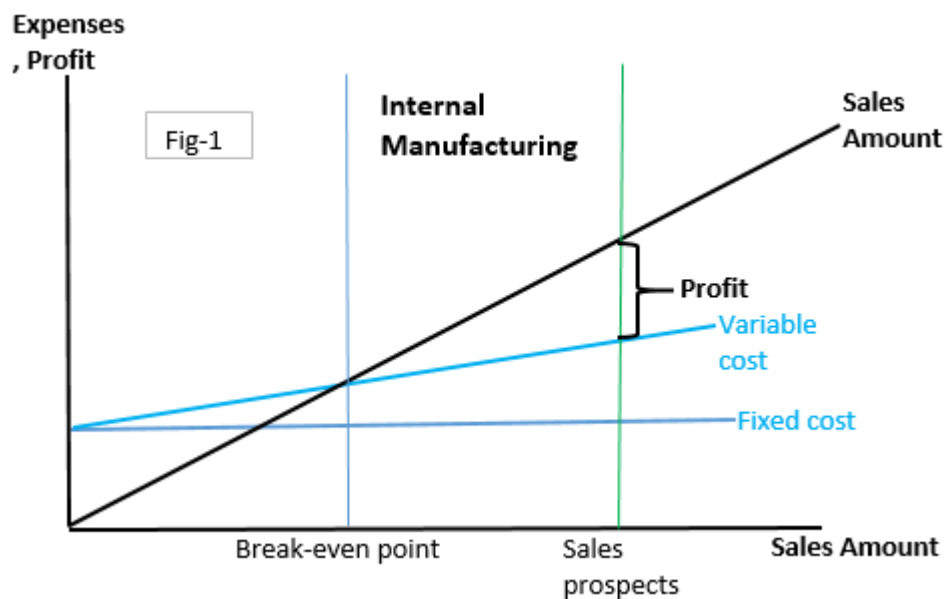


Fig- 1: Break-even point

— Fig-1 shows your company's situation of Break-even point, sales prospects in your share in the market, and the relation of Fixed cost, Variable cost, Sales amount and Profit. Easy? —I asked figuratively— ...Yes, of course easy for you. In Fig-1 I assume to be profitable. Exactly I don't know.

Then I draw the line oV [Variable cost: Outsourcing] showed in the above Fig-2. And I exposed the next lecture...

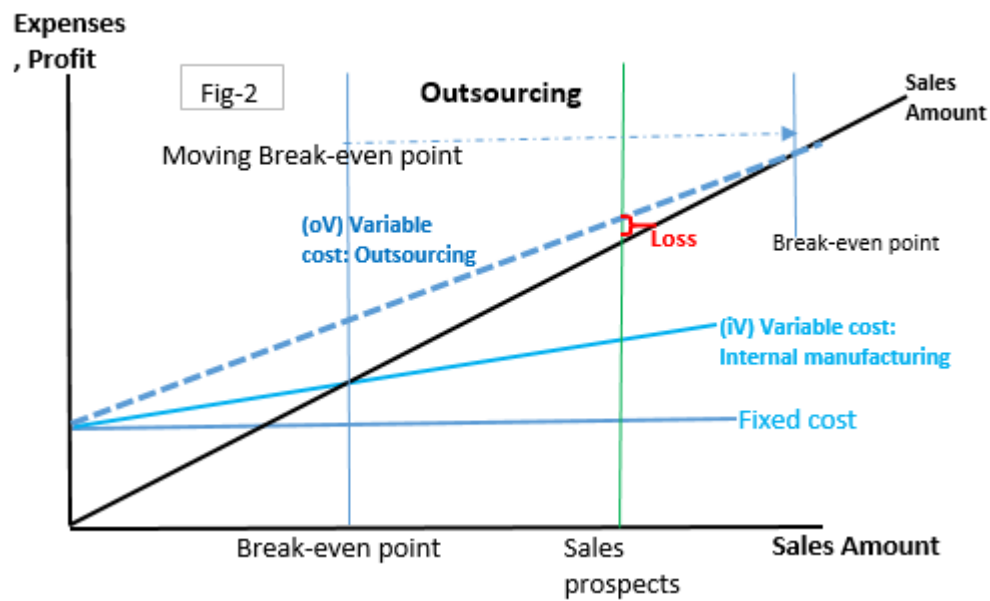


Fig- 2: Break-even point with the case of Outsourcing

Again:

$$\text{Marginal Profit} = \text{Sales amount} - \text{Variable cost}$$

And, the Outsourcing payment is Variable cost. And, this, oV is much higher than the Variable cost (iV) of Internal manufacturing.

Then, oV > iV.

And, V is the function of Sales amount. Therefore $y = Vx$.

Then, above Variable cost: outsourcing has bigger angle than Variable cost Internal manufacturing.

The important points are THREE.

One is oV > iV. Because:

$$\text{Cost} = \text{Variable cost} + \text{Fixed cost}$$

Major variable cost is material. And, it is same even if procured by subcontract or your company. And, this Variable cost of Outsourcing is included the outsourcing's Fixed cost (even though it is cheaper than yours).

Another point is the Break-even point moves to new Break-even point.

Because the angle of Variable cost of Outsourcing is larger than the Variable cost of Internal manufacturing.

And the Break-even point moved to new Break-even point which is located out of the point of Sales prospect. Then, as the result, It should be occurred the Loss in your business.

I don't know the exact figures. But it is quite true that your outsourcing policy harms the profit of your company.

Finally, I need to point out one point which is the necessary consideration about the reduction of Fixed cost, if you wish to continue the outsourcing policy. I explain it using next Fig-3.

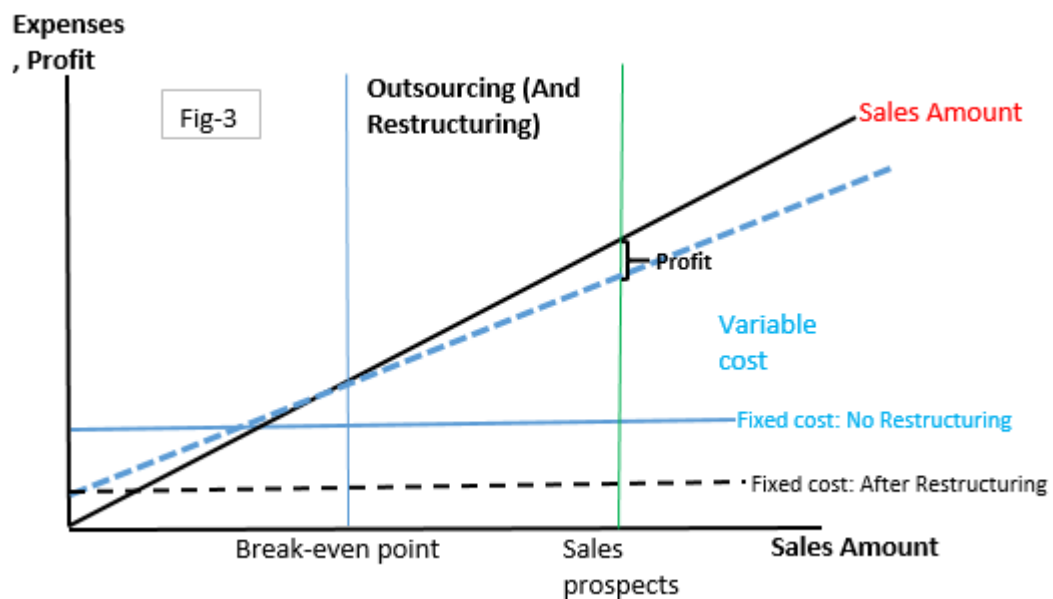


Fig- 3: Fixed cost by restructuring

If you wish to gain same profit in the condition of same Break-even point, Sales prospects with keeping outsourcing, it is necessary to reduce the Fixed cost in restructuring.

In above drawing, it can be re-draw in lowering the line of Variable cost of Outsourcing to the point where to meet the line and Sales Amount in same angle.

Then the zero point of Variable of Outsourcing to be zero is the necessary Fixed cost of After Restructuring.



When making conversation with my Japanese friends (accounting manager experience), such companies who misunderstand the use of outsourcing and believe the cost reduction.

Again, outsourcing must be used for next condition.

1. To supplement the function being insufficient internally.
2. Need equipment and technology not available in the company.
3. To cover fluctuations in demand. Demand fluctuates greatly and fixed resources cannot be kept

Fixed cost reduction: To recover and increase profit or to judge the production policy, the use of Break-even point chart is very useful and anyway it is very easy. (There is one difficulty which is to decide & standardize the variable and fixed costs.)

After last short lecture to the directors, we continued the conversation.

— And to recover and increase profit, it is important to reduce Fixed cost and Variable cost. Is it quite natural? —I asked the directors.

— Yes, it is very natural —they replied.

— Now, how to reduce Fixed cost and Variable cost? —I asked to the group without expecting any answer but detailing in this way...

— Variable cost: I believe you are considering and implementing the reduction activity of variable cost reduction such as: Scrap reduction and defect reduction in production process, VA/VE activity in design engineering, procurement method, direct selling expenses etc.

— On the other hand, how to reduce Fixed cost? —I answered to my self—, again, Fixed costs are: Labour cost (Direct and Indirect), Depreciation of machine & equipment, land & building, payment of patent and interest and etc.

— I believe you are considering the reduction of production excessive capacity in production line employees. —And I detailed—, reduction of production excessive labour capacity is easy as the activity.

— On the other hand, Indirect employee such manager, supervisor, group leader, material-handler, warehouse workers, maintenance engineer, production engineer, design engineer and office staff (administrative departments) who are Cost allocated, moreover Office rent and utilities, PCs and software leases, advertising, patent fee, depreciation of machine & equipment and land & building —I tried to end up—. All of them also must be needed to reduce.

The conversation was too wide a little and I tried to finish my lecture quickly.

— If you wish to do general cost reduction, it is necessary to make another project. Then I recommend to treat the problem in front of you. In this way, I never deny to reduce excess labour capacity. But the true purpose should be to recover the profit. Yes? —I asked figuratively.

— So, I recommend to do Break-even point diagnosis and to review the outsourcing policy immediately.

— We understand Sensei —directors agreed—. Then how about the request of consulting expansion (expansion of consulting contract from just TPM to wider.)?

— Sorry please let me consider —I answered but my thinking was the way of talk in Japan and, in such situation, it means the rejection in euphemism.

C. Break-even point (BEP) investigation.

Based on my suggestion, management team discussed the implementation of investigation about the outsourcing products with BEP. And, they decided to do it and report to the president.



1) Regrettable thing and Education of BEP.

This was strange, because some managers didn't know the BEP. It was fatal because managers don't know BEP. It is never the situation for just this company, but unfortunately is general.

In my previous company there is the training & education course when joining the company and I also got the accounting education and BEP.

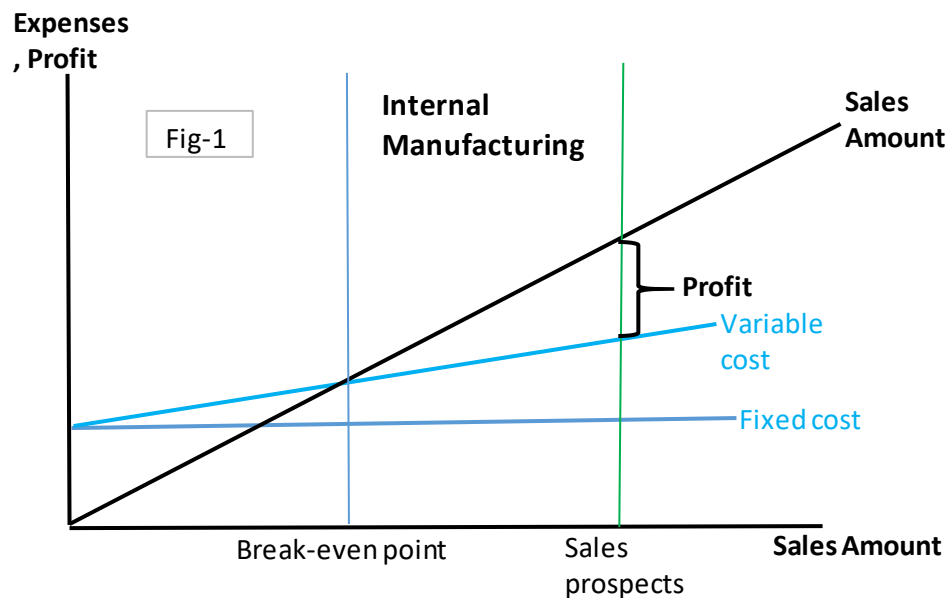
i What the profit as a Gemba is:

$$\text{Profit} = \text{Sales amount} - \text{Variable expenses (cost)} - \text{Fixed cost}$$

$$\text{Genkai Rieki} = \text{Sales amount} - \text{Variable expenses}$$

- **Genkai Rieki:** Marginal Profit (so called Throughput in TOC);
 - **Genkai:** Limit.
 - **Rieki:** Profit;
- What the variable expenses in Gemba is: (Omit...);
- What the Fixed cost is: (Omit...);

i What the BEP diagram is:



To gain and increase the profit, it is necessary to consider the improvement of Variable cost reduction, Fixed cost reduction and the increase of Sales amount.

When making a profit plan, it is required to consider these 3 points with BEP as quite natural thing.

I had seen the profit recovery plan of this company. But unfortunately, it was an action items and likely wish list which had no accounting background. Such low-level profit recovery action plan was submitted as the companywide activity in this company.

Anyway, the accounting department made the lecture of BEP to all managers.



My previous company makes the new employees' education as a standard which might not be a worldwide standard. And, in this education, accounting including BEP is made.

The project leader (She is an accounting staff.) made the lecture to other team members and Gemba supervisors. At that time the outsourcing products were used as the examples of BEP with actual figures.

And of course, they found and understood that the outsourcing policy was wrong and internal manufacturing with current labour and machine capacity was much better profitable. Also, it was required the sales amount increase and the efficiency increase (to support the sales increase).

Then they confirmed the direction which is "JIT machine condition" is match to the company's concern.



Problem

When discussing it, one difficulty was highlighted again. It was the issue of standard time accuracy. So, how to calculate the Fixed cost of BEP?

Again, Fixed cost: Labour cost (Direct and Indirect), Head office, Depreciation of machine & equipment, land & building, payment of patent and interest and etc.

And these are allocated with the standard time as next:

$$\text{Labour cost} = \text{Ourly rate} \times \text{SH (Standard Hour or time)} / \text{efficiency}$$

$$\text{Other fixed cost} = \text{Departmental unit cost} \times \text{SH} / \text{efficiency}$$

And,

$$\text{Departmental unit cost} = \text{Total other fixed cost} \times \text{Contribution degree to sales}$$

Anyway, one of serious factor was the standard time accuracy.

As I described before, this company has standard time system and each product have the standard time. However, the accuracy to actual time was bad. Then, they needed to confirm or modulate the relevant products standard time.

But it was quite clear that undoing relevant products to internal manufacturing is more profitable with tentative figures and BEP (Break-even point) investigation.

They had not so long-time grace (6 months). And they needed to implement following items:

1. Confirmation of standard time;
2. Re-calculation of profitability in BEP;
3. Reporting to president and getting his acceptance. (Standard departmental cost wasn't changed and used);
4. Line formation (layout, labours and machines, QC & inspection, material supply, supervising, material procurement);
5. Reporting to customers with the quality assurance system;
6. Work training;
7. Machine maintenance;
8. Information to customer and planning of undoing.



2) Imperial conference

After the confirmation of the profit plan of those outsourcing products, the results were reported to the president. With through the meeting, the plan which was the undoing of the products and parts was accepted by the president.



3) Small project for re-setup of production lines.

The Gemba was excited and got lively, because some employees had been having the concern of losing job for the outsourcing policy and past outsourcing.

Then management team and project team had a meeting and decided to implement the step of 8. Establish Development & Management system of Products and Equipment of Nakajima's 12 steps which this company's favorite.

Again, this step is to seek **Development of products that are easy to produce and machines that are easy to use.**

Of course, these undone products were not new products, but experienced and well-known products. But I dared to recommend to implement this step for a training for future.



Again 12 steps: NAKAJIMA 12 STEPS

To re-introduce these products, I recommended to use the technique of "Initial Products Quality Control" and the committee activity.

I described Initial Products Quality Control in TPM-1 as next (From TPM-1):

R&D? ...Yes I will write the new products development in the article of Initial Products Quality Control and the Committee.

In the Initial Products Quality Control, I describe the committee activity which includes Quality, Design engineering, Procurement, Production engineering, Sales, Subcontract Control, Human resources, Accounting & Financing, Production Control and of course Maintenance and Gemba for vertical start-up to eliminate the losses of new products start in Total Preventive Maintenance.

And, the aim of this activity is same to JIPM's TPM and is: **Development of products that are easy to produce and machines that are easy to use.**

I teach this in TQM for the development of "Product design, Process design, Machine & equipment including tools, Materials, Material plan, Human resources, Production plan, Sales plan":

- **Product design:** Making quality in design with confirming customer's needs, FMEA, Function deployment, Fish-bone- diagram, Past defect analysis & feedback.
- **Process design:** Layout, Work design, Line formation, Line-balance, Work element analysis, Time study, Working standard, Material handling.
Machine & equipment including tools (to seek better workability and trouble free): Peripheral equipment (PC, Material supply), Chute, Andon & indicator, Maintenance system, sensor, IoT, Recording system (for data gather), easy for Seiso, oil control, easy for setup, easy for takeout, safety devise, Poka-Yoke devise.
- **Material:** Function deployment analysis, Procurement plan, Supplier capacity, Inventory, Warehouse preparation,
- **Human resources:** Resource planning, Skill training & evaluation, PS (Preventive Safety) deployment,
- **Production plan:** Sales plan, Minimum inventory, Delivery plan,
- **Sales plan:** Sales amount (prospect), Visiting customer (Sales engineering), Customer's needs, Suggestion,

As you could imagine, the activity of Initial Products Quality Control is indeed companywide activity is required.

Therefore, I establish a committee, when I lead it. But it is also a fact that it is required a certain corporate capacity and the history or experience. Thus, it is not possible to gain sufficient result from the first and is required some certain experience.

Unfortunately, this company is not reached to this "certain level".

Anyway, this company decided to review the current outsourcing policy and undo the relevant products and work-in-progress to internal production. And the production Gemba was excited after along days.

I will describe the activity of the project & committee and new and temporal project of Initial Products Quality Control (IPQC).

Regarding IPQC, (in my teaching) it is the range of TQM. Then I describe it in TPM very shortly and give the deep description in TQM.

VI. Next Lecture

I write the continuation of bus tub curve and tribology and completion of the main theme (Control of lubricating oil).

Koichi Kimura CC4 – March-2020.